

Saturnian Phenomena. By the Rev. W. R. Dawes.

The night of May 17 was remarkably favourable, especially the earlier part of it, and afforded a very fine view of the expected transit of the shadow of *Titan* across the disk of *Saturn*.

Previously to the ingress of the shadow, I examined the planet most carefully with a power of 620 on my $8\frac{1}{4}$ -inch object-glass, which, when twilight had sufficiently faded, was well borne—the features of *Saturn* frequently coming out with beautiful distinctness, and the edge of the disk being sharply defined. The arms of the ring were scarcely at all visible; a very faint gleam of coppery light, at moments of finest vision, being the only indication of its existence beyond the disk of the planet. It has since been seen, on several occasions, much more plainly. On the disk the projected ring appeared as a very dark line a little north of the equator, and of uniform breadth. But I was much surprised that, under the finest definition with this high power, I could discern no trace of the *shadow of the ring*. I expected to see it, if the atmospheric circumstances were sufficiently good, as an *exceedingly fine black line*, stretched across the disk about a quarter of a second to the south of the inner edge of the projected ring; and that the shadow of the satellite would travel almost centrally on the black line—a great part of it, however, falling on the southern portion of the ring. But no such thing was to be found.

Having applied the parallel-wire micrometer with a power of 480, with which the planet was usually very sharply defined; as the expected time of ingress approached, I kept my eye steadily fixed on the eastern extremity of the dark line caused by the projected ring.

At 9^h 35^m G.M.T., the end of this dark line was observed to be decidedly enlarged, especially on its *northern side* (instead of the *southern*, as was expected).

At 9^h 37^m, the shadow was judged to have just completed its ingress.

At 9^h 40^m, a narrow thread of light was perceived outside the shadow, and on the northern side of the projected ring. It then became obvious that the shadow projected rather more than half its diameter to the *north* of the ring, and so little to the *south* of it that only under the finest views could any projection on that side of it be certainly perceived.

At 9^h 52^m, I carefully estimated that six-tenths of the diameter of the shadow projected from the northern edge of the ring.

After this time the state of the air greatly deteriorated, and I obtained with difficulty some micrometrical measures with powers 375 and 286. The result gave the distance of

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the satellite from its shadow in the direction of the axis-major of the ring $= 16''\cdot 06$.

At $12^h 10^m$, the shadow was judged to be in the middle of its transit, as determined by the webs of the micrometer.

The difference in the degree of darkness of the ring projected on the ball, and of the shadow of the satellite which fell upon it, was more striking than I expected. The ring looked like a line drawn with a good BB *lead-pencil*; the shadow resembled a *spot of ink*.

The position of the shadow with respect to the ring seems conclusively to prove that *Titan*, in that part of his orbit, is somewhat to the *north* of the plane of the ring, with which, therefore, the plane of his orbit is not absolutely coincident. This, indeed, seems to be the case with some of the interior satellites also.

The synodic period of *Titan*, computed from the observed transits of April 15 and May 17, comes out $= 15^d\cdot 967014$, from comparison of the times of complete ingress, and $= 15^d\cdot 966667$ from comparing the times of the shadow's attaining a central position; the mean of the two being $= 15^d\cdot 96684$. The period calculated from the actual orbital motion of the planet, and assuming the sidereal period $= 15^d\cdot 94543$, results $= 15^d\cdot 96967$; the difference amounting to about four minutes.

Nothing, I imagine, can more fully prove the *almost inconceivable thinness of the ring* than the absence of all perceptible shadow. Had it even the least thickness which has ever been ascribed to it (namely, forty miles, by Mr. G. P. Bond, Director of Harvard Observatory, at Cambridge, U. S.), it would be sufficient to produce a total eclipse of the Sun on *Saturn's* equator, as it would subtend an angle more than double that subtended by the disk of the Sun as seen from *Saturn*. This fact seems to me powerfully to support the conjecture which I threw out in my paper on the disappearance of the ring in 1848 (see *Monthly Notices*, vol. x., p. 46), as capable of accounting for the visibility of the ring when its unenlightened surface is turned towards the Earth, namely, *the existence of a pretty damp atmosphere on the rings*; through which the refraction of the light of the Sun, when nearly in the plane of the ring, would throw a pretty strong *twilight* upon them; and this would not only produce a slight degree of copper-coloured illumination upon the surface of the ring; but would also reduce the *shadow* of the ring on the ball to a slight *penumbra*; the *refracted light* from both surfaces of the ring, when the sun is nearly in its plane, being sufficiently strong to render the shadow of so thin a substance, as the ring undoubtedly is, quite undistinguishable.

On May 25 I observed, under sadly unfavourable circumstances, *an immersion of Titan in the shadow of Saturn*. The

state of the air was deplorably bad, and the planet was low at the time of the immersion. The light of the satellite gradually faded, until it was much less than that of *Dione* (then near its eastern elongation), and at last could only be certainly seen during the brief periods of more tranquil vision. The last of these occurred at about $12^h 30^m$ G.M.T.; and at the next tolerable view, which occurred at $12^h 33^m$, the satellite had totally disappeared.

Had the planet been near the meridian, and the air in a good state, I believe the observation might have been made with a considerable degree of certainty. It may be hoped that the excellent opportunities which have lately occurred of observing the Saturnian phenomena in America will not have been neglected.

I am not acquainted with any other observation of an eclipse of this satellite; and it is the first which I have been able to see, though constantly on the watch for it near the times of the disappearance of the ring in 1848, and in the present year.

On June 2, the shadow of *Titan* again transited the disk of *Saturn*. The sky was most unfavourable; yet a tolerable view of the planet, at about $8^h 50^m$ G.M.T., showed the shadow notching the eastern edge; and at $8^h 55^m$ the shadow had completed its ingress. When it had advanced some way on the disk, I carefully estimated that it projected about as much from the *south* side of the ring, as seen on the planet, as on May 17 it projected from the *north* side of it. Highest useful power, 296. Before the shadow arrived at the middle of its transit, clouds completely covered the sky.

The comparison of the times of ingress, on May 17 and June 2, gives the synodic period $= 15^d.97500$, being about $1^m 40^s$ greater than the calculated period.

Hopefield Observatory, Haddenham, Thame,
1862, June 10.

June 11. The eclipse of *Titan*, last night, was lost through clouds.

On a Solar Spot. By R. Hodgson, Esq.

The large group of spots which has passed across the Sun's disk during the last fortnight was so peculiar in its formation that upon the 8th inst. I made a micrometrical drawing of it. When it first appeared on the Sun's limb, it was a series of circular and nucleated spots, not quite in contact with each other; as it approached the centre of the Sun, they spread out